Missing Entropy Problem in Naturally Layered CMR Single Crystals

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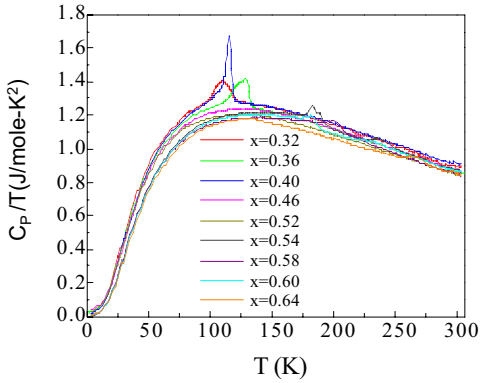
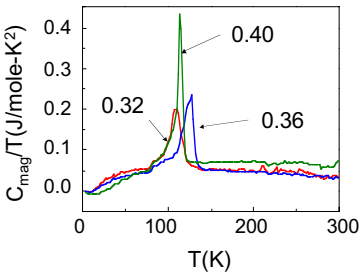
MOTIVATION

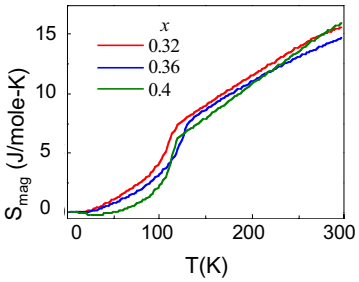
- Magnetic entropy change in $SrO(La_{1-x}Sr_xMnO_3)_2$ layered manganites
  Theoretical estimation : $\Delta S_{mag} = Nk[\ln(2S+1)-\ln 1]=R\ln(2S+1)$, For $0.32 \le x \le 0.64$, ΔS_{mag} : 25.6 ~ 24.4 J/mole-K
  Experimental results : ~ 16 J/mole-K (FM composition)
- Discrepancy between measured magnetic entropy change ΔS_{mag} and theoretically estimated value : **"Missing" Entropy ?**

RESULTS

$La_{2-2x}Sr_{1+2x}Mn_2O_7$





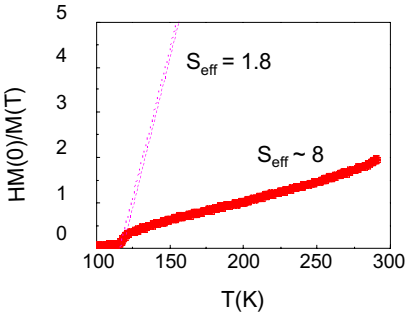


- Measure $C_{lattice}$ using a nonmagnetic analog of 2d-LSMO sample
  ⇒ measure heat capacity of $SrO(La_{1-x}Sr_xMnO_3)_2$ with various x values
  (minimize the changes in the lattice contribution to the heat capacity)
  ⇒ decompose lattice and magnetic contributions

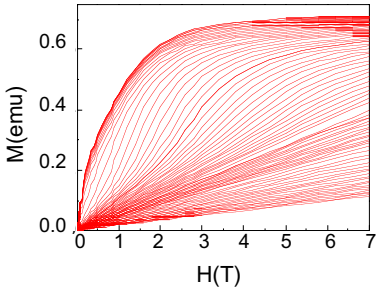
$C_{mag}(x) = C\text{-}C_{lattice}$ ($x = 0.52$) (for $x = 0.32$, 0.36, and 0.40)

x = 0.40 sample

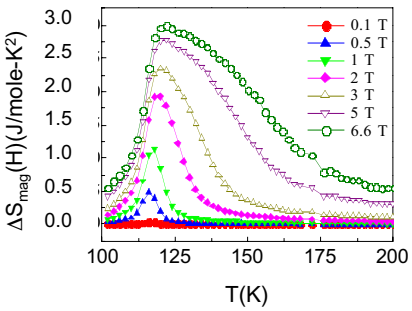
Inverse DC susceptibility ($1/\chi$)



M(H)



$\Delta S_{mag}(H)$ (T)



IMPACT and FUTURE DIRECTIONS

- A large discrepancy between the values extracted experimentally and those expected theoretically based on Rln(2S+1)
  ⇒ significant amount of the anticipated magnetic entropy is removed above T_C
  ⇒ random clusters above T_C that lead to the Griffiths singularity might provide the short range order that would account for the missing entropy
- Future works : higher temperature measurements, better lattice backgrounds, and further theoretical modeling

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